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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/773,317	02/09/2004	Fusazumi Masaka	026035-00010	6655

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EXAMINER

LEWIS, BEN

ART UNIT	PAPER NUMBER
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1745

DATE MAILED: 10/19/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/773,317

Applicant(s)

MASAKA ET AL.

Examiner

Ben Lewis

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-11 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date ____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: ____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on October 2nd, 2006 has been entered. Claim 1 has been amended. Claims 7-11 were added.

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 1-11 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

3. The term "good" in claim 1 is a relative term which renders the claim indefinite. The term "good" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Claims depending from claims rejected under 35 USC 112, second paragraph are also rejected for the same.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bonsel et al. (U.S. Patent No. 6,197,147 B1) and further in view of Sompalli et al (U.S. Paten No. 6,524,736).

With respect to claims 1 and 11, Bonsel et al teach a process for continuous production of membrane-electrode composites wherein to improve the adhesion and to bond the components, the contacting material or at least one flat face of the membrane or both components can be incipiently dissolved, wetted or incipiently swollen by a solvent or by a polymer solution, and the components, i.e. one or both flat faces of the ion-conductive membrane and at least one electron-conductive contacting material, can then be fitted together by pressing and bonded by lamination (Col 6 lines 34-42). Bonsel et al does not specifically teach wherein a good solvent for the electrolyte membrane is applied to at least one of facing surfaces of the opposed electrode substrate. However, Sompalli et al. teach methods of preparing membrane electrode

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assemblies wherein in the pretreatment approach, a porous support substrate is coated with a wetting solvent such that the solvent is imbibed into the pores. A slurry is formed including an ionically conductive material, a catalyst supported on an electrically conductive material, and a solvent that is non-wetting to the porous substrate. The slurry is well mixed and applied as a layer to the surface of the porous support substrate and dried to form a film. The film is applied to a membrane, and heat and pressure are applied to form a membrane electrode assembly. Advantageously, this method controls the drying to form a more robust electrode by preventing electrode shrinkage and subsequent cracking of the electrodes (Col 1 lines 45-67). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the coating of the electrode substrate of Sompalli et al into the MEA fabrication process of Bonsel et al because Sompalli et al teach that advantageously, this method controls the drying to form a more robust electrode by preventing electrode shrinkage and subsequent cracking of the electrodes (Col 1 lines 45-67).

Regarding the good solvent being applied in an amount of from $0.001\text{mg}/\text{cm}^2$ to $10\text{mg}/\text{cm}^2$. The disclosure Bonsel et al as modified by Sompalli et al differs from Applicant's claims in that Bonsel et al as modified by Sompalli et al do not disclose disclose any coating weight per unit area data of the solvent. However, Sompalli et al. recognize the need to control the amount of solvent used in the coating process since Sompalli et al teach that controlling the content of non-wetting solvent in the slurry is very important as it determines the rate of drying of the catalyst layer and the degree of intrusion, and subsequent loss, of Nafion into the porous support. As a result, the non-

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wetting solvent content affects the structural integrity of the catalyst layer, and the Nafion content in the electrode. High non-wetting solvent content leads to mud-cracking of the catalyst layer due to non-uniform drying, and seriously compromises its robustness. Low non-wetting solvent content leads to increased seepage of Nafion into the support, and too great a loss of Nafion reduces structural support as the Nafion provides the bond holding the catalyst and catalyst support together with the ionomer (Col 9 lines 30-45). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to control the amount of solvent used in the coating of membrane of Bonsel et al. as modified by Sompalli et al. to within the range as claimed by Applicant because Sompalli et al recognizes the need to control the amount of solvent used in the coating process. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art. In re Boesch*, CCPA 1980, 617 F.2d 272, 205 USPQ215.

With respect to claim 2, Bonsel et al teach that for coating, the membrane is taken past the slot die either in the horizontal direction (above or below the die) or in the vertical direction (ascending or descending). In the case of conditioning on both faces of the membrane, the application of the solvent or polymer solution can be carried out correspondingly by passing the membrane through by means of two slot dies or by

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conditioning of the membrane in a dipping bath which contains the solution to be coated (Col 6 lines 64-67; Col 7 lines 1-4).

With respect to claim 3, Bonsel et al teach that the coating of the components can be carried out either with pure solvent or with a polymer solution, in which case the polymer concentration can amount to 0 to 100% by weight, preferably 5 to 50% by weight. Preferably, a polymer solution of the polymer forming the ion-conductive membrane is used for coating (Col 6 lines 43-57). Alternatively, the membrane can be coated by taking it past a blade (film casting). The width of the blade is preferably in the range from 0.1 to 5 m with a slot width in the range from 5 to 500 μm . The ribbon speed is in this case especially between 0.5 mm/second and 10 m/second, preferably 5 mm/second to 1 m/second (Col 7 lines 5-10).

With respect to claims 4 and 6, Bonsel et al teach that the ion-conductive membrane is used as a membrane which contains a polymer from the group comprising the polyarylether-ketones, polyarylene sulfides, polyarylether-sulfones, poly-(1,4-phenylene)s and polybenzimidazoles or from the group comprising the sulfonated polyaramides or a completely fluorinated polymer.

With respect to claim 5, Bonsel et al teach that in order to improve the adhesion between the membrane and the contacting material, the membrane can, if appropriate, be at least partially plasticized before the lamination process either by swelling in a

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non-solvent, for example water, acetone, methanol or another aliphatic alcohol, or by swelling in mixtures of a solvent, preferably a predominantly polar aprotic solvent, for example N-methylpyrrolidone (NMP), dimethyl sulfoxide (DMSO), dimethylformamide, g-butyrolactone, or protic solvents such as, for example, sulfuric acid or phosphoric acid or a non-solvent.

With respect to claim 7, Bonsel et al teach that one possibility for such a conditioning comprises, for example, passing the laminate in ribbon form through a drying section, for example a circulating air oven, heated to 10 to 250 °C., especially 20 to 200 °C. In this way, still adhering solvent residues or water are evaporated (Col 7 lines 54-67).

With respect to claim 8, Bonsel et al teach that in a further process variant, the removal of the superfluous, still adhering components can take place in a downstream washing step. Thus, for example, still adhering solvents or non-solvents or polymer components can be extracted by a liquid which does not dissolve the membrane-forming polymers. For example, water/NMP mixtures and mixtures of NMP and lower aliphatic alcohols are used here (Col 8 lines 1-15).

With respect to claim 9, Bonsel et al teach that for coating, the membrane is taken past the slot die either in the horizontal direction (above or below the die) or in the vertical direction (ascending or descending). In the case of conditioning on both

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faces of the membrane, the application of the solvent or polymer solution can be carried out correspondingly by passing the membrane through by means of two slot dies or by conditioning of the membrane in a dipping bath which contains the solution to be coated (Col 6 lines 64-67); (Col 7 lines 1-5).

With respect to claim 10, Bonsel et al teach that preferably, the contacting material and/or the ion-conductive membrane are brought together as two-dimensional structures and laminated at a temperature in the range from 5 to 300 °C., especially 25 to 200 °C., and a suitable contact pressure, preferably in the range from 10^7 to 10^{12} Pa, especially 10^8 to 10^{10} Pa (Col 7 lines 10-25).

Response to Arguments

6. Applicant's arguments filed on October 2nd, 2006 have been fully considered but they are not persuasive.

Applicant's principal arguments are

(a) It is not disclosed that a good solvent is applied to at least one of the facing surfaces of the opposed electrode substrate and the electrolyte membrane, in order to bond the membrane with the electrode substrates. Bonsel et al. suffers from the problem that by applying the sulfonated polymer solution to the surfaces of the membrane an interlayer

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is formed between the membrane and the electrode substrate, and the thickness of membrane-electrode assembly is increased.

(b) Sompalli et al. fails to remedy the deficiencies of Bonsel et al., as it does not disclose using any solvent during the step of bonding an electrode to a membrane, much less using 0.001 to 10 mg/cm² of solvent.

(c) On the other hand, in the claimed invention, the good solvent is used in minimal amount, 0.001 mg/cm² to 10 mg/cm², such that the adhesion between the electrolyte membrane and the electrode substrate is not poor, and the membrane is not deformed by swelling or dissolution. See page 36, lines 18-24 of the specification.

(d) No evidence has been provided to demonstrate that any such suggestion can be found in the knowledge available to those skilled in the art. Applicants submit that there is no motivation for one skilled in the art to alter the disclosures of Bonsel et al. and Sompalli et al. to arrive at the presently- claimed invention.

In response to Applicant's arguments, please consider the following comments.

(a), (b) Bonsel et al does not specifically teach wherein a good solvent for the electrolyte membrane is applied to at least one of facing surfaces of the opposed electrode substrate. However, Sompalli et al. teach methods of preparing membrane electrode assemblies wherein in the pretreatment approach, a porous support substrate is coated with a wetting solvent such that the solvent is imbibed into the pores. A slurry

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is formed including an ionically conductive material, a catalyst supported on an electrically conductive material, and a solvent that is non-wetting to the porous substrate. The slurry is well mixed and applied as a layer to the surface of the porous support substrate and dried to form a film. The film is applied to a membrane, and heat and pressure are applied to form a membrane electrode assembly. Advantageously, this method controls the drying to form a more robust electrode by preventing electrode shrinkage and subsequent cracking of the electrodes (Col 1 lines 45-67). Therefore it would have been obvious to one of ordinary skill in the art to incorporate the coating of the electrode substrate of Sompalli et al into the MEA fabrication process of Bonsel et al because Sompalli et al teach that advantageously, this method controls the drying to form a more robust electrode by preventing electrode shrinkage and subsequent cracking of the electrodes (Col 1 lines 45-67).

(c) Regarding the good solvent being applied in an amount of from $0.001\text{mg}/\text{cm}^2$ to $10\text{mg}/\text{cm}^2$. The disclosure Bonsel et al as modified by Sompalli et al differs from Applicant's claims in that Bonsel et al as modified by Sompalli et al do not disclose any coating weight per unit area data of the solvent. However, Sompalli et al. recognize the need to control the amount of solvent used in the coating process since Sompalli et al teach that controlling the content of non-wetting solvent in the slurry is very important as it determines the rate of drying of the catalyst layer and the degree of intrusion, and subsequent loss, of Nafion into the porous support. As a result, the non-wetting solvent content affects the structural integrity of the catalyst layer, and the

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Nafion content in the electrode. High non-wetting solvent content leads to mud-cracking of the catalyst layer due to non-uniform drying, and seriously compromises its robustness. Low non-wetting solvent content leads to increased seepage of Nafion into the support, and too great a loss of Nafion reduces structural support as the Nafion provides the bond holding the catalyst and catalyst support together with the ionomer (Col 9 lines 30-45). Therefore, it would have been within the skill of the ordinary artisan to control the amount of solvent used in the coating of membrane of Bonsel et al. as modified by Sompalli et al. to within the range as claimed by Applicant because Sompalli et al recognizes the need to control the amount of solvent used in the coating process. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art.* In re Boesch, CCPA 1980, 617 F.2d 272, 205 USPQ215.

(d) Bonsel et al does not specifically teach wherein a good solvent for the electrolyte membrane is applied to at least one of facing surfaces of the opposed electrode substrate. However, Sompalli et al. teach methods of preparing membrane electrode assemblies wherein in the pretreatment approach, a porous support substrate is coated with a wetting solvent such that the solvent is imbibed into the pores. A slurry is formed including an ionically conductive material, a catalyst supported on an electrically conductive material, and a solvent that is non-wetting to the porous substrate. The slurry is well mixed and applied as a layer to the surface of the porous support substrate and dried to form a film. The film is applied to a membrane, and heat and pressure are applied to form a membrane electrode assembly. Advantageously,

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this method controls the drying to form a more robust electrode by preventing electrode shrinkage and subsequent cracking of the electrodes (Col 1 lines 45-67). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the coating of the electrode substrate of Sompalli et al into the MEA fabrication process of Bonsel et al because Sompalli et al teach that advantageously, this method controls the drying to form a more robust electrode by preventing electrode shrinkage and subsequent cracking of the electrodes (Col 1 lines 45-67).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ben Lewis whose telephone number is 571-272-6481. The examiner can normally be reached on 8:30am - 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's Trainer, Susy Tsang-Foster can be reached on 571-272-1293. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Ben Lewis


SUSY TSANG-FOSTER
PRIMARY EXAMINER

Patent Examiner
Art Unit 1745